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Cartridge Filter Housings Update

by Unai Jauregui

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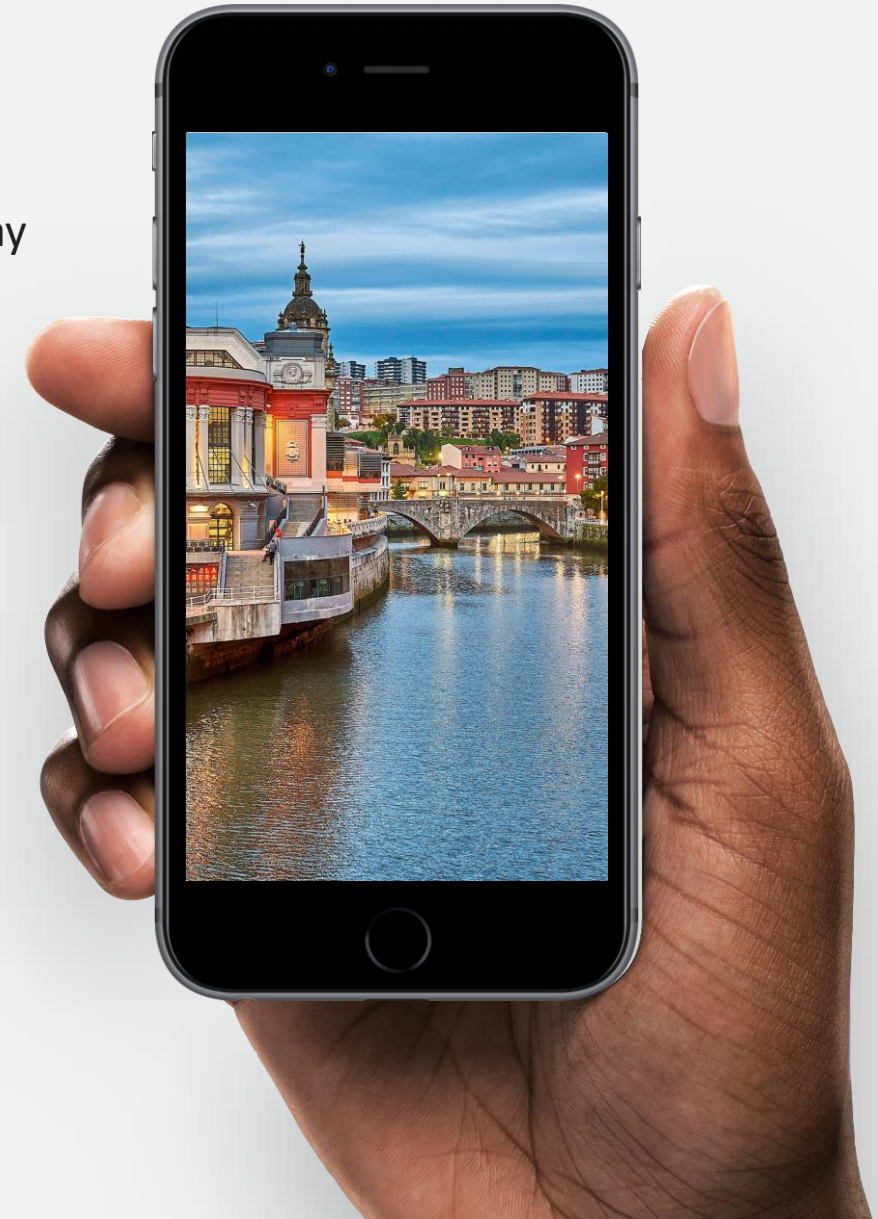
Question: References of Cartridge Filter housings.
How many references do we already have for >100,000 m³/day projects?

Options:

- 5
- 25
- 18
- 10



1. References of SWRO Plants >100,000 m³/day

- **A total of 18 references**
- **9 out of 18 were awarded after Dubai Symposium**

Piedmont

Customer	Project	Country	Capacity	Year
Abengoa	Taweelah	UAE	909 000	**2019**
Abengoa	Jubail 3A	Saudi Arabia	600 000	**2020**
Acciona	Jubail 3B	Saudi Arabia	570 000	**2022**
Acciona	Shuqaiq III	Saudi Arabia	450 000	**2019**
Acciona	Shuqaiq I	Saudi Arabia	400 000	**2021**
Abengoa	Agadir-Chtouka	Morocco	275 000	**2018**
Abengoa	Shuaibah III Exp.2	Saudi Arabia	250 000	**2018**
Acciona	Al Khobar	Saudi Arabia	250 000	**2019**
Rawafid	SWCC satelites	Saudi Arabia	240 000	**2019**
Tedagua	TUAS III	Singapore	200 000	**2017**
Nijhuis (for Keppel)	Marina East SWRO	Singapore	200 000	**2019**
Acciona	Tseung Kwan O	China	135 000	**2020**
Aguas Antofagasta	Antofagasta	Chile	105 600	**2019**
Tedagua	Ras Al Khaimah	UAE	100 000	**2018**
Al Dayer	Basrah	Iraq	100 000	**2020**
Metito Egypt	El Arish	Egypt	100 000	**2020**
Acciona	Laguna Lake	Philippines	100 000	**2021**
Metito Egypt	Sfax	Tunisia	100 000	**2022**

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2. Styles – Cartridge Filter Housings

QPV-STYLE Quick Opening System

Main Features

Maximum 7 elements of 40”/50” (1 high flow 60” element also available)

Especially designed for low flows up to 35 m³/h (or 60 m³/h in case of HF)

Horizontal and vertical orientation

Ideal for stock

Competitive price based on minimum quantities

Q-STYLE Quick Opening System

Main Features

Quick opening. No bolts

Low Flows: Up to 390 m^3/h

Modular/Skid/Container

Q Style

HV-Q Style

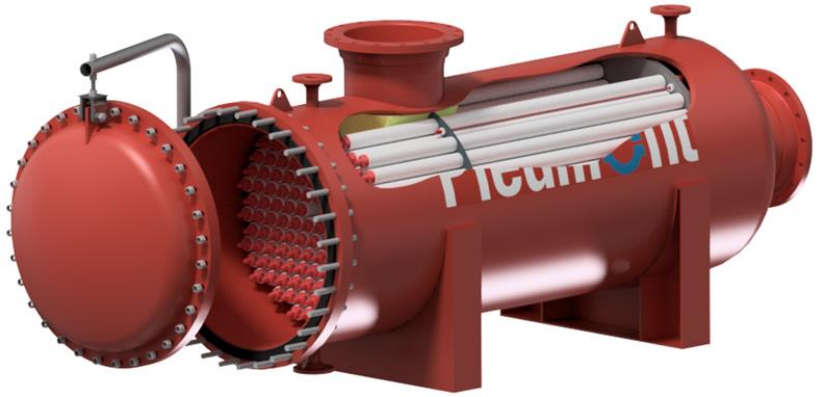
XS-STYLE Side Inlet System

Main Features

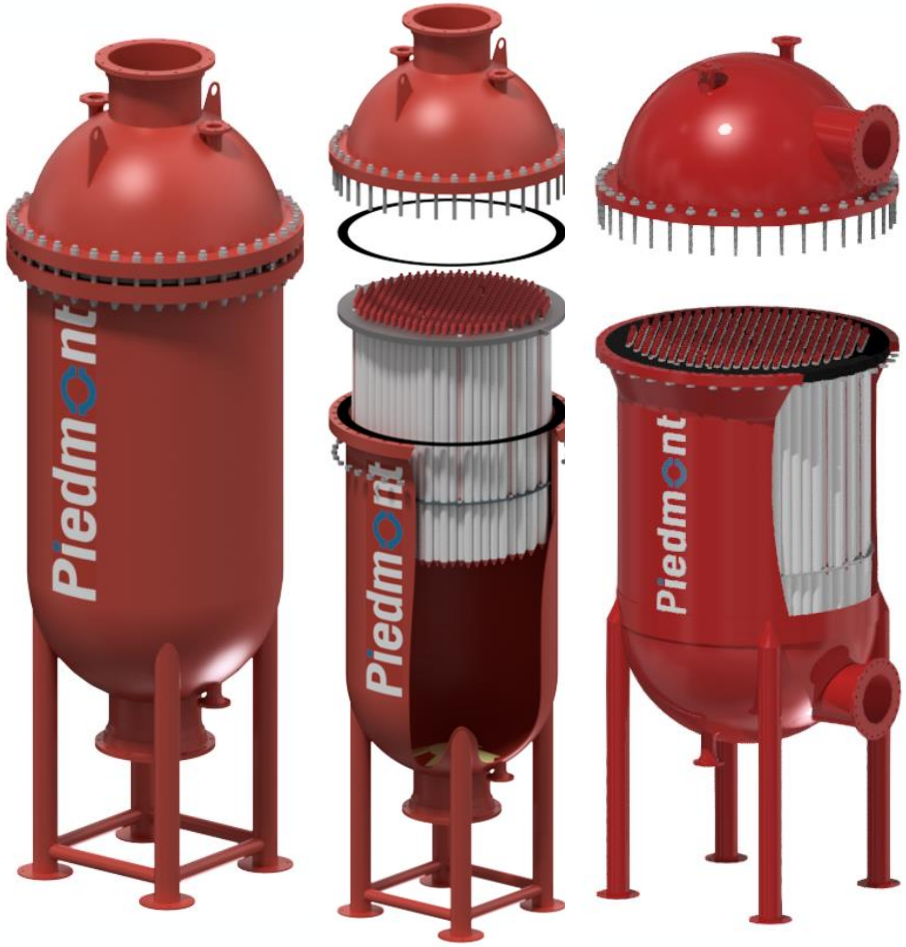
High Flows & Stand alone

Side Inlet / bottom outlet

Davit Arm Available



XB-STYLE Bottom Inlet System – Removable Package



Main Features

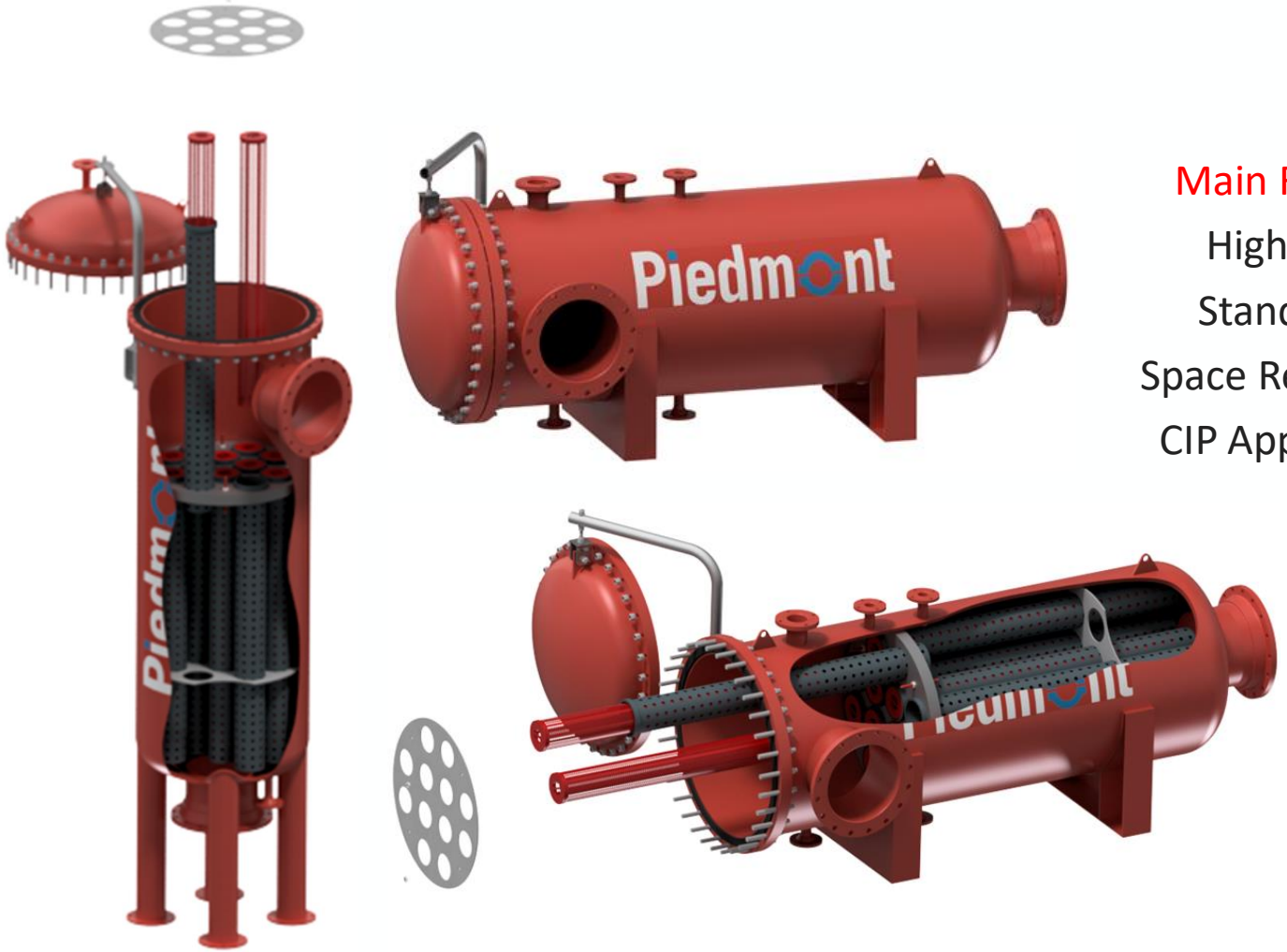
High Flows

Stand alone

Easy Maintenance

Common configuration large scale desal plants

HV-X-STYLE High Flow Standard Opening System
HH-X-STYLE High Flow Standard Opening System Horizontal



Main Features

High Flows

Stand alone

Space Restrictions

CIP Applications

B-Q-X-STYLE Bag Filter - Quick Opening System
S-Q-X-STYLE Basket Strainer - Quick Opening System

Style B-Q

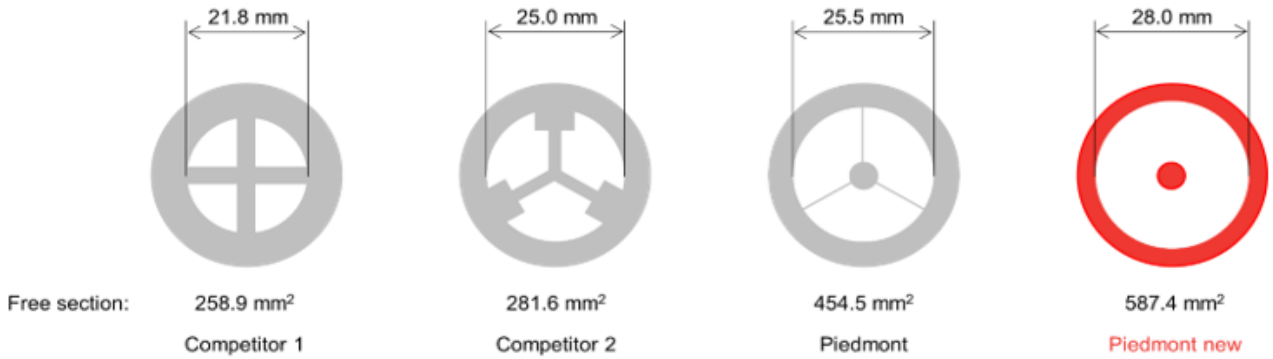
Style B-X

Style S-Q

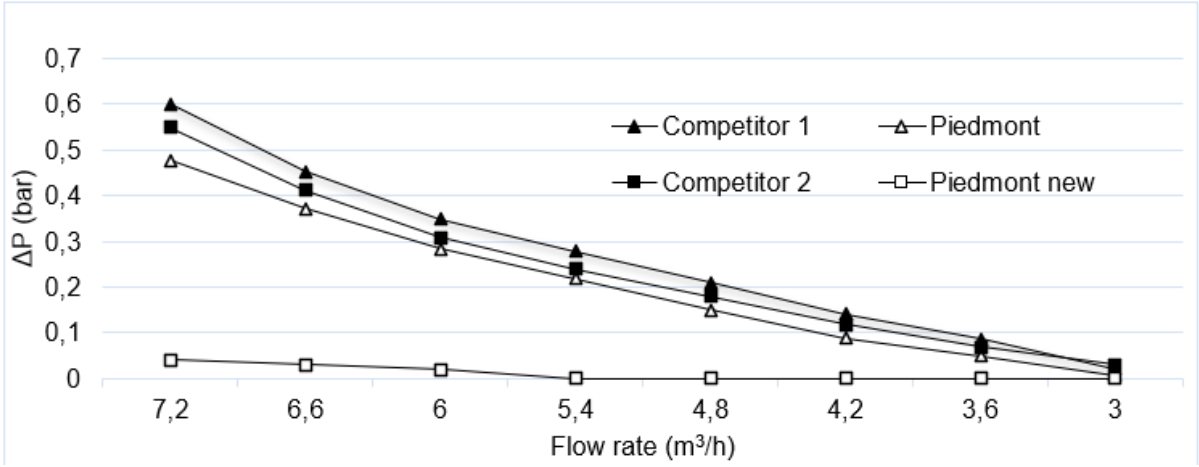
Stringwound	Meltblown	Pleated
		
Depth filtration **Nominal filtration**	**Nominal filtration** **Absolute filtration**	**High flow capacity** **Absolute filtration**

3. New Internal Support Rods (ISR)

Cross section of cartridge filter ISR at the tube sheet



Pressure drop (ΔP) across a cartridge filter as a function of flow rate

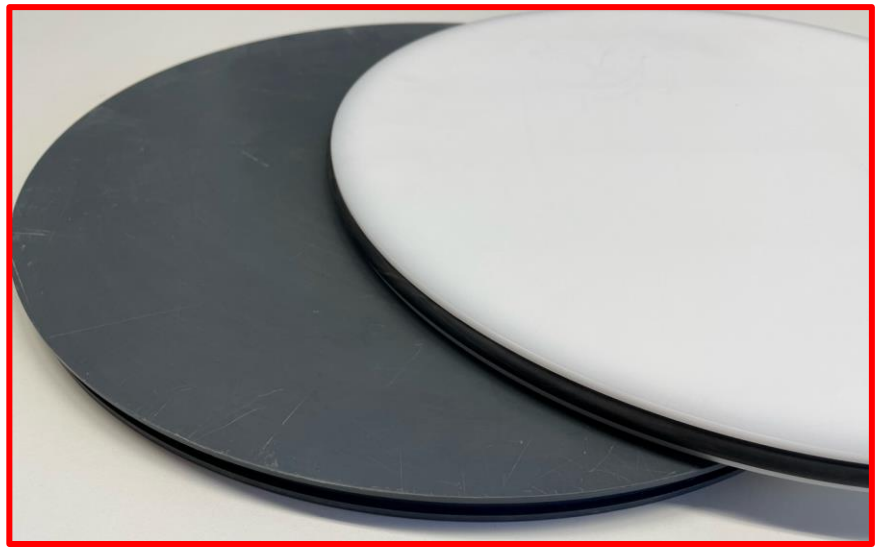


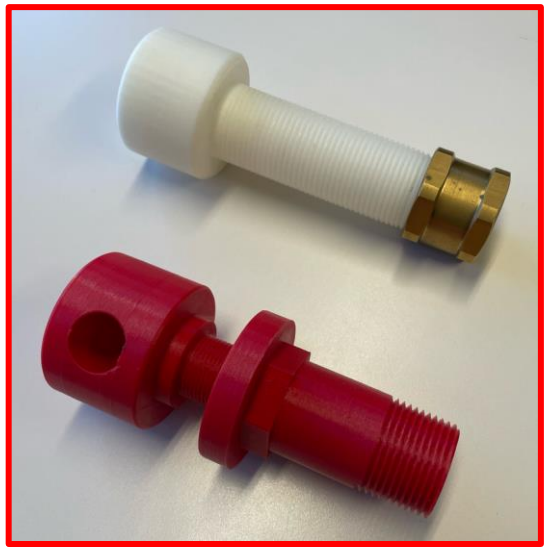
4. Main Improvements / Changes in CFH

Style Q

Main issues were leakages and the sealing plate was the origin of most of them:

- Sealing plate MOC. We have changed to POM with a thermal expansion coefficient four times less than PE (previous material).
- Sealing plate machining accuracy has been improved.
- Sealing gaskets are one single piece and vulcanized. Previous gaskets were glued. It lost its properties in the connecting point and there was a risk of breaking.
- Drain and vent connections. We are working on new NPT connections.





4. Main Improvements / Changes in CFH

- False bottom plate thickness has been reduced
- False bottom plate has been embedded to reduce the risk of leakages at 50%
- More number of bolts and of smaller size to reduce the risk of leakages
- Orientation of connecting flanges to reduce the costs by avoiding elbow, and to reduce the total height of the filter housings and the structure around, including piping

4. Main Improvements / Changes in CFH

- Thickness of the guide plates. The aggressivity of the TIE designs jeopardizes the strength of the bundle of elements because of the differential pressure and the tensions are being generated inside the filter housings.
- Lifting lugs are manufactured and supplied in super duplex material instead of FRP.

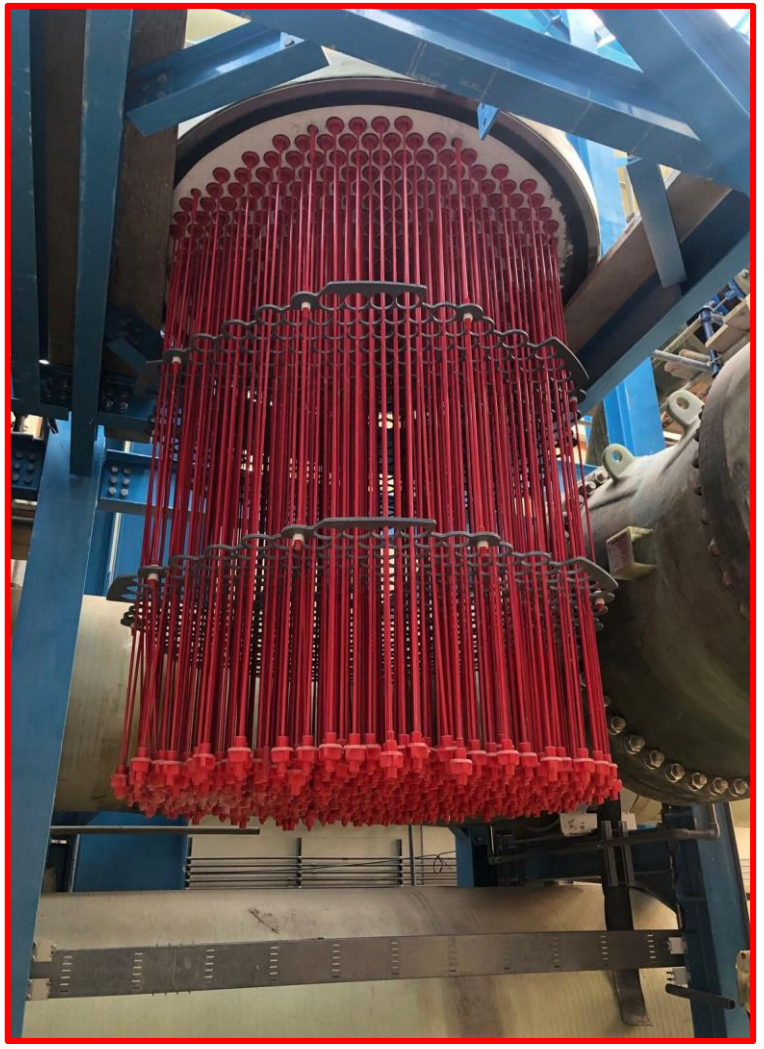
4. Main Improvements / Changes in CFH

- We have modified the MOC of plastic internal parts taking into account the incompatibility of the Polyamide with sulfuric acid (applicable to ISR)
- Limitation of the total height of the filter housings for projects to 4 meters. This will allow to introduce three units into a 40’ container instead of two units
- MOC of supporting baskets for high flow cartridge elements. They are manufactured now in carbon fiber to strength their mechanical properties
- ASME X. Trying to improve our competitivity.

5. Opportunities - Spare Parts, Consumables, ISR, Large Diameter Housings & Revampings

Recommended Spare Parts

Gaskets
Ext. Bolts
Guide Plates
ISR
Rods
Baskets



5. Opportunities - Spare Parts, Consumables, ISR, Large Diameter Housings & Revampings

Chemical Cleaning of the cartridge elements

- **Innovation type:** Improvement of an existing process.
- **Why?** To reduce the cost and waste of cartridge filtration.
- **How?** Cleaning and reusing cartridge elements using specialty chemicals to extend their usable life.

5. Opportunities - Spare Parts, Consumables, ISR, Large Diameter Housings & Revampings

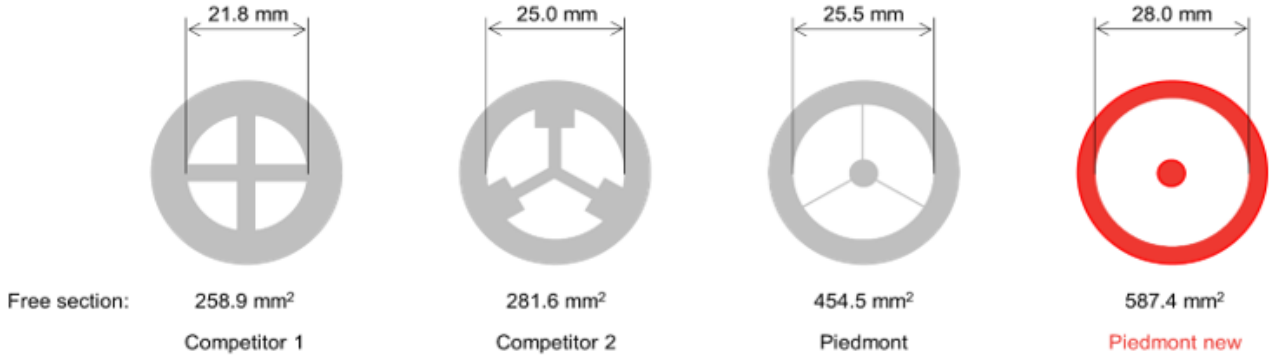
Chemical Cleaning of the cartridge elements

Based in CF CIP in a SWRO plant:

- **OPEX reduction** – Less cartridge elements needed
  - Cartridge lifetime: Extended by 51%
  - Payback: Less than 4 months
- **Waste reduction** – About 500 Kg of waste reduced
- **CO_2 emissions reduction** – Savings from cartridge manufacturing, shipping and disposal

5. Opportunities - Spare Parts, Consumables, ISR, Large Diameter Housings & Revampings

Cross section of cartridge filter ISR at the tube sheet



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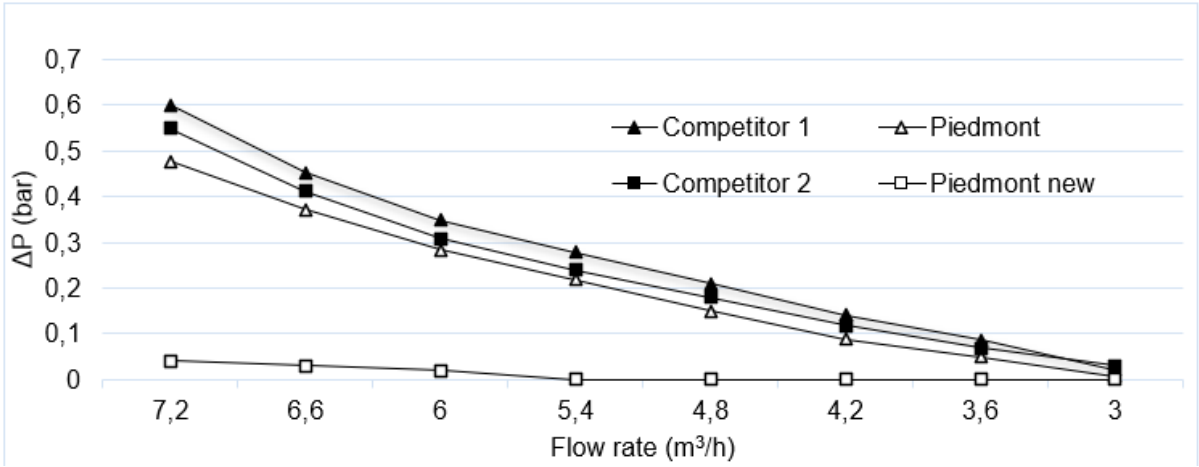


5. Opportunities - Spare Parts, Consumables, ISR, Large Diameter Housings & Revampings

Case study: Payback Calculation - Considerations

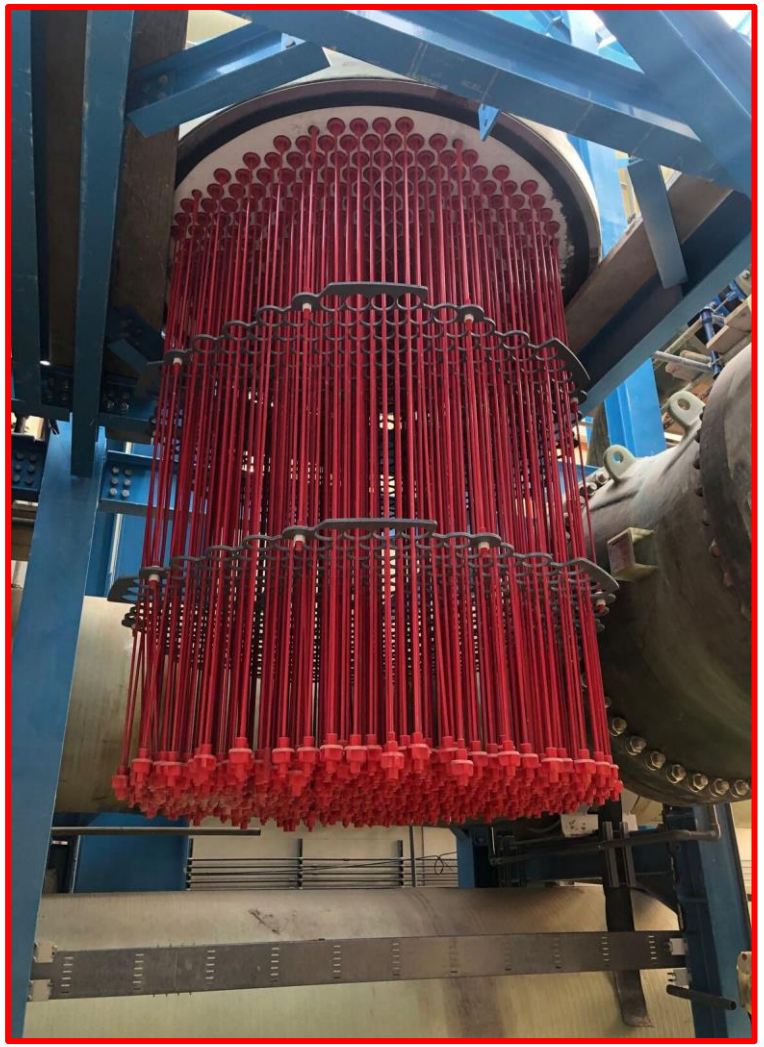
- 100,000 m^3 /day (4167 m^3/h) SWRO plant
- Number of cartridge filters: 6 filters with capacity for 129 cartridges of 70” length
- Flow per cartridge: 5.39 m^3/h (TIE: 0,77 m^3/h/10”)
- Number of Internal Support Rods: 129 per filter, 774 in total.
- Specific Energy Consumption (SEC): 4 kWh per 1 barg and 100 m^3/h
- Type of support rods initially installed: Competitor 1
- Initial DP in the old support rods: 0,2025 barg
- Price of new ISR: 30 USD/each
- Electricity price: 0,068 USD per kWh

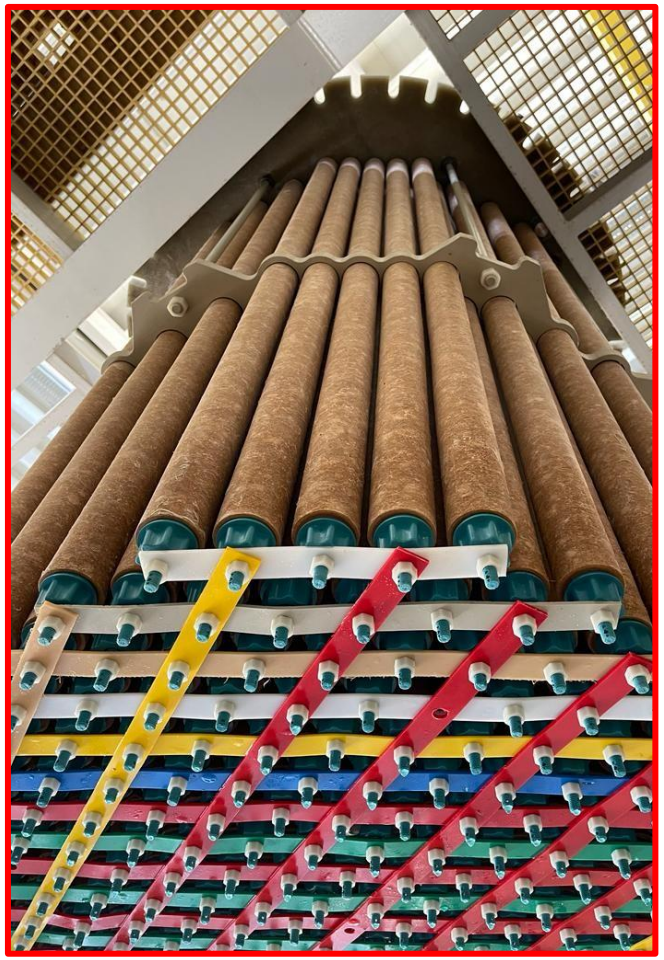
5. Opportunities - Spare Parts, Consumables, ISR, Large Diameter Housings & Revampings

Case study: Results - OPEX reduction

- **Total investment** for 774 ISRs: **23,220 USD**
- DP after new ISR installation: **≈0 barg**
- **Energy savings** per year: 295,887 kWh
- Total annual **energy cost savings**: 20,120 USD
- **CO_2 emissions** saved: 118 tons per year
- **Payback**: 1 year, 1 month and 26 days. 86,65% recovered in the first year.

5. Opportunities - Spare Parts, Consumables, ISR, Large Diameter Housings & Revampings





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Question: ISR.
Why are we able to reduce the differential pressure?

Options:

- Because we have modified the material to PP+fiberglass
- Because we have increased the surface at the narrowest section of the ISR
- Because we have increased the internal diameter of the cartridge elements
- All the above

5. Opportunities - Spare Parts, Consumables, ISR, Large Diameter Housings & Revampings

Advantages:

- Reduction of the total number of housings
- Reduction of required foot print
- Reduction of the units of the required auxiliary equipment
- Our competitors have a limitation in their manufacturing capabilities
- Price: A DN2400 filter housing is10% less if compared to a DN1500 filter housings

Disadvantages:

- Logistics. Our customer will need a flat rack because sizes do not fit into a container
- Stand by units are always needed
- Larger size for auxiliary equipment is required
- Lack of references in the market for filter housings larger than DN1900

DN	Description	Qty	Total price EUR FCA Piedmont facilities
1500	XB-PCF-370-70 PN6 EN13121	18+1	-
1900	XB-PCF-605-70 PN6 EN13121	11+1	-7.39%
2400	XB-PCF-950-70 PN6 EN13121	7+1	-9.85%

5. Opportunities - Spare Parts, Consumables, ISR, Large Diameter Housings & Revampings

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Question: Chemical cleaning of cartridge elements.
Which are the benefits of cleaning the cartridge elements?

Options:

- To extend the life of the cartridge elements
- To reduce CO2 emissions
- To reduce waste disposals
- All the above


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